Validation of a Mountain Quail Survey Technique

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VALIDATION
OF A
MOUNTAIN QUAIL
SURVEY TECHNIQUE

Completion Report

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ABSTRACT

For the past several decades, mountain quail populations throughout the Intermountain Region of the U.S. have been declining. As a consequence, managers have become concerned about the possibility of extirpation of remnant populations. However, because so few studies have been done on the species, information that would enable managers to develop effective management plans is unavailable. As a first step toward collecting more information on the species, managers have expressed a need for an economical and efficient means of surveying mountain quail.

Mountain quail are a species of special concern. They exhibit secretive behavior, exist in low densities, and occur in isolated patches of dense cover in steep terrain. Therefore, a species-oriented calling survey, in targeted habitats, would be the most efficient way to begin gathering data on their presence. We determined that a modified calling survey, in which imitated calls are used to stimulate quail vocalizations, might be the most efficient survey method, as presentations designed to elicit responses might increase the likelihood that quail will be detected when present. The purpose of this study was to use the known presence of radio-collared mountain quail to determine the efficacy of such a calling survey, as well as determine optimum conditions and number of visits for such a survey.

During May 1994, we conducted calling surveys in 5 areas in the Little Salmon River Canyon, in west-central Idaho. Surveys were conducted during 4 time periods, using 2 calls, and 2 broadcasting methods. At least 1 radio-collared mountain quail was present in each area throughout the survey period. We found that more vocalizations were detected in the 2 earliest time periods (starting at sunrise or 1000), under mild weather conditions (no precipitation and little or no air movement). When surveys were done under these conditions, and routes were visited at least twice, the presence of mountain quail was detected in 4 of 4 draws.

We believe that the survey recommendations presented here will be useful for detecting the presence of mountain quail in targeted areas, and that this type of survey is the most efficient method available in terms of time and labor costs. Results of these surveys may document the presence of mountain quail, establish the location of breeding range, yield information on cover type associations, and provide information on regional distribution. In addition, annual surveys could provide data on population trend and range expansion or contraction. Thus, mountain quail calling surveys can prove a valuable first step toward increasing our knowledge of the species' population dynamics and habitat requirements.

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VALIDATION OF A MOUNTAIN QUAIL SURVEY TECHNIQUE

INTRODUCTION

Mountain quail (*Oreortyx pictus*) have recently become the focus of concern throughout the Intermountain Region of the western U.S. due to population declines and contraction of range over the past several decades. In Idaho, this native quail historically occurred along the Boise, Snake, Salmon, Little Salmon, and Clearwater river systems (Murray 1938, Ormiston 1966, Brennan 1989, Robertson 1989, Robertson 1990). However, the species' distribution in Idaho has experienced the same pattern of decline since the late 1930's (Figure 1). Brennan (1990, 1994) offered several causes for the decline of mountain quail in Idaho, including deterioration and loss of habitat due to intensive agriculture, cattle grazing, and water impoundments along the Snake River.

As a result of this decades-long decline, the mountain quail has been classified as a "Species of Special Concern" by the Idaho Department of Fish and Game and as a "Sensitive Species" by the Bureau of Land Management and Regions 1 and 4 of the U.S. Forest Service. In 1991 the U.S.D.I. Fish and Wildlife Service listed mountain quail as a Category 2 (C2) candidate species. C2 candidates are: "Taxa for which information now in possession of the U.S. Fish and Wildlife Service indicates that proposing to list as endangered or threatened is possibly appropriate, but for which conclusive data on biological vulnerability and threat are not currently available to support proposed rules. Further biological research and field study may be needed to ascertain the status of taxa in this category" (U.S. Department of the Interior 1991). Although little additional data on the species' status has become available since

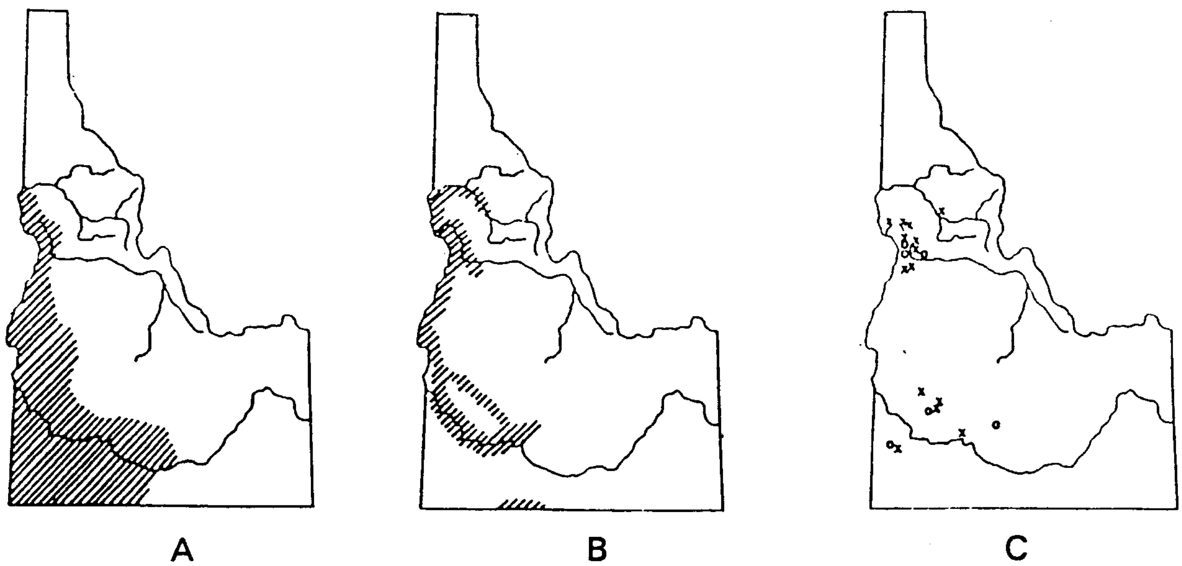

Figure 1. Changes in the distribution of mountain quail in Idaho during the past 50 years. Map A is based on data from Murray (1938). Map B is based on Ormiston (1966). Map C represents current distribution of mountain quail in Idaho, mapped from confirmed (X) and unconfirmed (0) sightings between 1984 and 1989 (Robertson 1989).

1991, the classification was changed to category 3C. Category 3C taxa are those which ". . . have proven to be more abundant or widespread than previously believed and/or those that are not subject to any identifiable threat" (U.S. Department of the Interior 1994).

Lack of detailed data on the distribution, abundance, life history, habitat use patterns, and population ecology of mountain quail is due, in large part, to the bird's secretive nature, low numbers, and use of dense vegetation in steep terrain. Even when closely approached, mountain quail tend to remain quiet and stationary, or move silently away from searchers. This behavior, together with their occupancy of thick brush where accessibility and visibility are limited, makes it difficult to detect their presence, and has been a major barrier to the study of this species. However, without better information on the species' distribution, population dynamics, limiting factors, and habitat needs, wildlife and land managers lack key elements needed for effective management plans. Without such knowledge, strategies for restoration of habitat and re-introduction of mountain quail may not succeed.

Justification

While results of our on-going, long-term mountain quail study will provide basic biological and ecological information on mountain quail, the need for reliable information on regional population numbers and distribution remains. Without such knowledge, management actions may be inefficiently applied or may be inadequate to prevent the species from becoming endangered or extinct in the region. Development of a suitable, effective survey method will enable managers to conduct efficient and reliable searches for mountain quail.

Whereas trapping or intensive searches using several searchers and dogs may increase the probability of detection of mountain quail, these methods are highly labor- and time-intensive and their use would thus limit the number of areas that may be investigated. In addition, the steepness, isolation and, often, roadless nature of the targeted survey areas, and the logistics involved in coordinating searchers and their dogs, combine to make intensive searches impractical. Another method for estimating population size and density, the line transect, may be unsuitable for use with mountain quail, as the species' behavior, low densities, and habitat use patterns make it unlikely that assumptions of this method will be met.

Considering the lack of feasibility of trapping, line transects, and intensive searches for mountain quail, the calling or call-count survey, may be the most efficient method for gathering information on the presence of the species in targeted areas. Detection of calls can provide information on regional distribution by providing data on minimum number present, as well as population trend over time, if the surveys are repeated annually. Furthermore, using imitated vocalizations or broadcasting taped vocalizations of may increase the probability of detecting individuals by eliciting responses (Stirling and Bendell 1966, Levy et al. 1966, Fuller and Mosher 1981). Additionally, while several authors (Robbins 1981, Bibby et al. 1992, Ralph et al. 1993) advocate completing surveys within an optimum timeframe, or caution against conducting surveys in poor weather conditions, little information exists as to the optimum methodology, number and timing of visits, as well as weather parameters, of a mountain quail calling survey.

We radio-collared 24 mountain quail in the late winter and early spring of 1994. Because radio-telemetry enabled us to accurately and repeatedly determine the locations of these collared quail, this provided us with an opportunity to evaluate a calling survey. The purpose of this study was to use the known locations of radio-collared mountain quail in selected draws off the Little Salmon River Canyon to validate the efficacy of a calling survey, using broadcast vocalizations, to detect the presence of mountain quail. The study was also designed to collect information on differential success of detection over various temporal and weather conditions. In addition, our past experience with this quail population, as well as data collected from radio-collared birds in the late winter and early spring of 1994, yielded information on timing of movement from winter to breeding range and the habitat use patterns of mountain quail during the breeding season.

OBJECTIVES

1. Determine locations and movements of radio-collared mountain quail during the breeding season.
2. Collect weather and cover type information for mountain quail locations.
3. Determine the efficacy of calling surveys for determining the presence of mountain quail.

DESCRIPTION OF STUDY AREA

This mountain quail survey study was conducted in conjunction with our on-going research in west-central Idaho, centered on the Little Salmon River Canyon in the area of Pollock, Idaho. Predominant land uses in this area are logging and livestock grazing, as well as residential development along the Little Salmon River. In general, the land adjacent to, and immediately upslope of the Little Salmon River is privately owned, while the higher-elevation, forested lands are publicly-owned. Topographically, the area consists primarily of steep, dissected slopes with basaltic outcrops and ridges. South-facing slopes are generally arid and dominated by perennial bunchgrasses and invading annual grasses, together with several species of forbs and sub-shrubs. In the numerous small draws and on the mesic north-facing slopes, mountain shrub communities are common. Moister areas and higher-elevation slopes support stands of mixed conifers. The dominant species of woody vegetation found in the Little Salmon River Canyon near Pollock, Idaho and where the mountain quail occur, are listed in Table 1.

SURVEY METHODS

We periodically located radio-collared mountain quail to determine the timing of movement from winter to breeding range. After the quail had moved to breeding range and males had commenced more intense yelping, we selected survey routes for this study (Figures 2, 3, and 4). Surveys were conducted throughout May and each survey area was occupied over the course of the study period by at least 1 radio-collared mountain quail.

Potential sources of bias affecting the detection of calling by mountain quail include selection of the target habitat, characteristics of the observer (hearing ability and familiarity with the species' vocalizations), and characteristics of the bird (individual differences in behavior, mated status, temporally-mediated activity), as well as timing of survey period (both within the 24-hour period and within the season). In addition, poor weather conditions, such as precipitation and wind, may negatively affect bird activity or the observer's ability to hear or see the birds (Bibby et al. 1992, Ralph et al.

Table 1. Dominant species of woody vegetation the Little Salmon River Canyon, Idaho. Scientific nomenclature follows Hitchcock and Cronquist (1973).

Scientific Name	Common Name
Abies grandis	grand fir
Acer glabrum	Rocky Mountain maple
Alnus spp.	alder
Amelanchier alnifolia	serviceberry
Betula occidentafis	water birch
Ceanothus spp.	buckbrush
Celtis reticulata	hackberry
Cornus stolonifera	red-osier dogwood
Crataegus spp.	black hawthorn
Holodiscus discolor	ocean-spray
Philadelphus lewisii	syringa
Physocarpus malvaceus	ninebark
Pinus ponderosa	ponderosa pine
Populus tremuloides	quaking aspen
Populus trichocarpa	black cottonwood
Prunus spp.	chokecherry, bittercherry
Pseudotsuga menziesii	Douglas fir
Rhus glabra	smooth sumac
Rhus radicans	poison ivy
Ribes spp.	currant, gooseberry
Robinia pseudo-acacia	black locust
Rosa spp.	wild rose
Rubus spp.	blackberry
Salix spp.	willow
Sambucus cerulea	blue elderberry
Symphoricarpos albus	snowberry

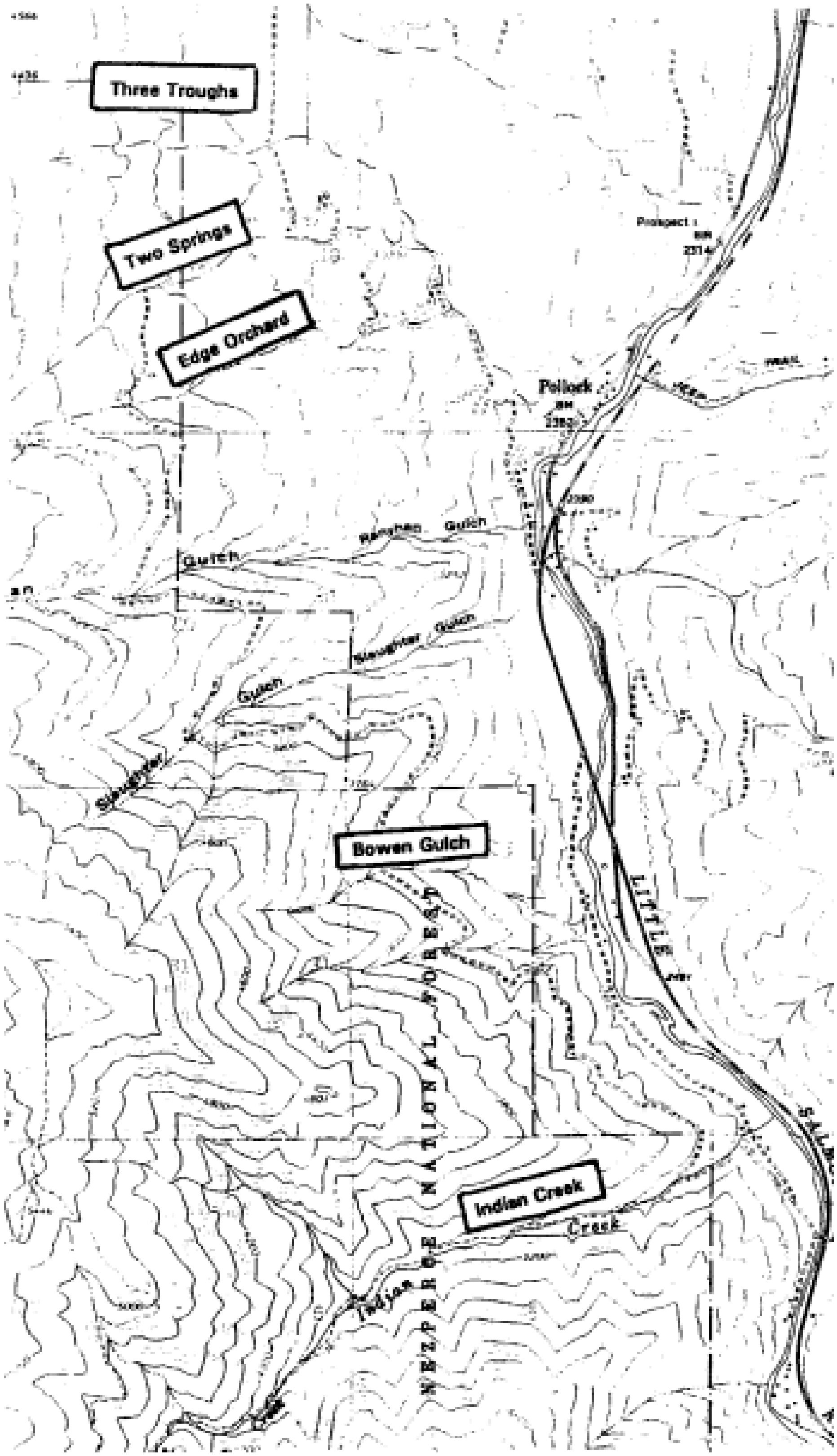

Figure 2. Routes for mountain quail calling surveys, Little Salmon River Canyon, Idaho, 1994.

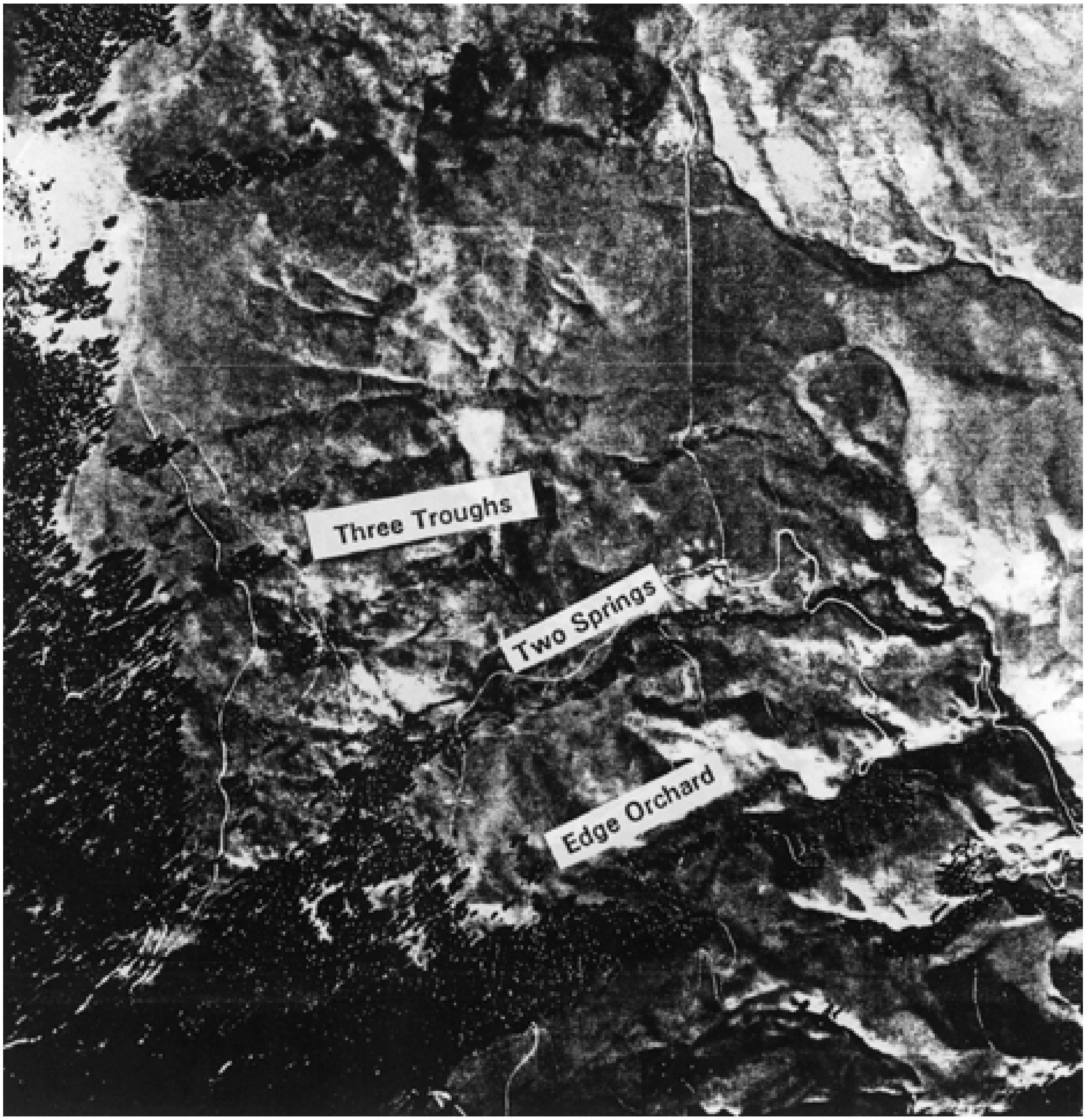

Figure 3. Aerial photograph of Three Troughs, Two Springs, and Edge Orchard routes, mountain quail calling survey, Little Salmon River Canyon, Idaho, 1994.

Figure 4. Aerial photograph of Bowen Gulch and Indian Creek routes, mountain quail calling survey, Little Salmon River Canyon, Idaho, 1994.

1993). If poor weather conditions existed at the beginning of the survey route, and persisted through a half-hour waiting period, we did not initiate the survey. If the poor weather conditions arose during the survey, and made detection of quail impossible, the survey was discontinued.

Selection of survey routes was determined by the presence of at least 1 radio-collared mountain quail. To detect effects of temporal and weather conditions and collect information on time and distance covered, for each survey visit we recorded the date, survey route name, time, elevation, UTM coordinates, and weather conditions at both starting and ending points. Weather conditions included temperature, precipitation, cloud cover, and wind speed. Cloud cover and precipitation categories are listed in Appendix A, and wind speed categories are listed in Appendices A and B. At each station on the survey route, we recorded the elevation, presentation method, presence of radio-collared quail and their frequencies, and number of mountain quail vocalizations heard. After a training period, all surveys were conducted by 1 observer, to reduce variability in observer effects.

To determine if success in eliciting a response was related to time of day, we varied the survey timeframes among 4 starting times: sunrise, 1000, 1500, and no earlier than 2 hours before official sunset (Appendix A). When possible, each target area was surveyed at least once during each time period.

Length of the survey route, as well as beginning and ending points, depended on location of the radio-collared quail, landowner permission, topography, and interfering sounds at lower elevations. Survey stations were approximately 200 meters apart and were upslope, out of the bottom of the drainage, to eliminate the interfering sounds of running water.

We used 3 different broadcast presentation methods in an attempt to elicit yelping responses. To determine if there were differences in effectiveness between the 3 presentation methods, these, were varied over the course of the route and on each visit. The presentation method at each station consisted of a 2-minute listening period, followed by a 2-minute broadcast presentation, followed by another 2-minute listening period. The initial listening interval (IL) at the starting point of each route was analyzed separately. Broadcast presentations then varied between a taped yelp (TY), a yelp produced using a hand-held call (CY), or an assembly call produced using the hand-held call (CA). Survey presentation method codes are listed in Appendix A. We used an Iverson Mountain Quail call to produce the CY and CA presentations.

RESULTS

Timing of Movement and Cover Types: In 1994 radio-collared mountain quail moved to breeding range between mid-March and mid-April, generally moving from lower to higher elevations. On breeding range, we located the quail in the conifer/shrub and mountain shrub cover types. The conifer/shrub cover type was comprised of an open-canopy forest of mixed conifers, often predominated by ponderosa pine *(Pinus ponderosa),* with a dense understory of shrubs. The mountain shrub communities were dominated by black hawthorn *(Crataegus douglasii),* ninebark *(Physocarpus malvaceus), Ribes* spp. and *Rosa* spp., and occasionally contained aspen (*Populus tremuloides).* Cover type codes are listed in Appendix A.

Length, Number of Stations. and Time Elapsed: We surveyed 5 areas during May, for a total of 17 routes with 133 stations. We surveyed 4 of the routes once during each of the 4 time periods, and a fifth route during time period 2. Excluding the fifth survey route and 2 survey visits shortened due to poor weather conditions, the average number of stations was 7, the mean linear distance covered per survey route was 1271 meters, and the mean elapsed time per survey visit was 147 minutes. Summary information on each survey route is contained in Tables 2 and 3.

Initial Responses by Presentation Method: Mountain quail have a large repertoire of vocalizations, but most of them only carry a few meters. The male's yelp, which peaks in frequency and intensity during the breeding season, can be heard up to 300 m away and may be the most easily-elicited call. We considered only initial responses of individuals as elicited vocalizations; that is, if a mountain quail began yelping in the listening interval following a CA presentation, and then continued yelping during the following station, we considered it to have responded only once, at the station where the initial response occurred. For the 133 opportunities (stations) there were 9 initial responses, producing an overall detection rate at stations of 7%. When we analyzed responses in all draws by type of presentation, the CA presentation elicited the highest response rate, at 13% (5 responses to 40 presentations), the CY presentation generated a response rate of 5% (2 responses to 40 presentations), and the TY method elicited the fewest responses, at 3% (1 response to 36 presentations). One vocalization was detected at 1 of 17 IL opportunities, for a response rate of 6% (Table 4).

Influence of Temperature, Wind and Precipitation: Temperatures throughout all surveys were generally mild to warm. The lowest temperature recorded, at the starting point for Two Springs during time period 1, was 32°F; the highest temperature, at the beginning point for Indian Creek during time

Table 2. Summary of survey routes, mountain quail survey technique study, Little Salmon River Canyon, Idaho, 1994.

Survey Route	Date	Julian Date	Time Period	Number of Collared Quail Present	Number of Survey Stations	Linear Distance Covered (meters)	Time Elapsed (minutes)
Edge Orchard	05-10-94	130	1	6	8	1400	230
	05-01-94	121	2	6	9	1600	190
	05-19-94	139	3	3	6	1000	85
	05-20-94[a]	140	4	6	5	800	100
Two Springs	05-01-94	121	1	6	11	2000	200
	05-16-94	136	2	5	8	1400	130
	05-15-94[a]	135	3	1	4	600	80
	05-02-94	122	4	6	9	1600	95
Indian Creek	05-16-94	136	1	1	6	1000	130
	05-02-94	122	2	1	7	1200	140
	05-09-94	129	3	1	6	1000	130
	05-07-94	127	4	1	6	1000	110
Bowen Gulch	05-19-94	139	1	3	6	1000	140
	05-09-94	129	2	3	7	1200	160
	05-06-94	126	3	3	8	1400	145
	05-19-94	139	4	3	6	1000	100
Three Troughs	05-18-94	138	2	2	4	600	90

[a] Route discontinued due to poor weather conditions

Table 3. Summary, by survey route, of time period, temperature, wind force, and precipitation, mountain quail survey technique study, Little Salmon River Canyon, Idaho, 1994.

		Temperature		Wind Force		Precipitation				
Survey Route	Time Period	Beg	End	Beg	End	Beg	End	Number of Responses	Number of Stations	Percent
Edge Orchard	1	40	81	0	1	0	0	2	9	22
	2	67	70	1	1	0	0	1	10	10
	3	63	65	2	4	0	1	0	7	--
	4	55	55	3	2	1	2	0	6	--
Two Springs	1	32	50	1	2	0	0	2	12	17
	2	57	77	1	2	0	0	1	9	11
	3	63	59	2	4	1	2	0	5	--
	4	70	62	2	2	0	0	0	10	--
Indian Creek	1	44	47	1	0	0	0	1	7	14
	2	70	71	1	1	0	0	0	8	--
	3	88	--	1	0	0	0	0	7	--
	4	75	--	2	0	0	0	0	7	--
Bowen Gulch	1	45	53	1	0	0	0	0	7	--
	2	75	86	1	1	0	0	1	8	13
	3	69	70	1	1	0	0	1	9	--
	4	57	56	2	1		0	0	7	--
Three Troughs	2	61	64	1	1	0	0	0	5	--
Summary								9	133	7

Table 4. Summary of quail responses, all routes, by type of presentation, mountain quail survey technique study, Little Salmon River Canyon, Idaho, 1994.

Presentation Method	Number of Responses	Number of Stations	Percent
Initial Listen (IL)	1	17	6
Taped Yelps (TY)	1	36	3
Call Yelps (CY)	2	40	5
Call Assembly (CA)	5	40	13

period 3, was 88°F. The highest ending point temperature, 86°F, was recorded during time period 2 at Bowen Gulch (Table 3).

Wind speed readings (mph) were converted to numeric force code following the Beaufort Scale of Wind Force (Appendix B) for easier categorization and analysis. During most visits to survey routes, Beaufort wind force categories were 0, 1, or 2. During 2 visits to Edge Orchard, however, winds were gusty and were categorized as wind force 2, 3, or 4, and no mountain quail vocalizations were detected during those visits (Table 3). All detected quail vocalizations were recorded under conditions of wind force categories at the beginning of 0 or 1, and at the end of 0, 1, or 2. When wind force categories at the beginning of the survey visit were 2 or 3, no quail vocalizations were detected (Table 5).

Ability to detect quail vocalizations also appeared to be influenced by amount of precipitation. Vocalizations were recorded only under conditions of no precipitation at the beginning and end points of a survey route; for 115 stations with such conditions, the response rate was 8% (Table 6).

Table 5. Summary of quail responses, all routes, by wind force category, mountain quail survey technique study, Little Salmon River Canyon, Idaho, 1994.

Wind Force Beg	Category[a] End	Number of Responses	Number of Stations	Percent
0	1	2	9	22
1	0	1	21	5
1	1	3	40	8
1	2	3	21	14
2	0	0	7	--
2	1	0	7	--
2	2	0	10	--
2	4	0	12	--
3	2	0	6	--

[a] Beaufort wind force categories (Appendix B)

Table 6. Summary of quail responses, all routes, by precipitation, mountain quail survey technique study, Little Salmon River Canyon, Idaho, 1994.

Precipitation Beg	End	Number of Responses	Number of Stations	Precent
0	0	9	115	8
0	1	0	7	--
1	2	0	11	--

Influence of Time of Day: The time period during which the survey was conducted also seemed to influence quail vocalizations and responses. When all presentation stations (n = 133) were included, surveys done during time periods 1, 2, and 3 produced response rates of 14, 8, and 4%, respectively. No vocalizations were detected in time period 4. Considered another way, 8 of the 9 responses (89%) were recorded in either time period 1 (5 responses) or time period 2 (3 responses) (Table 7).

Table 7. Summary of quail responses, all routes, by time period, mountain quail survey technique study, Little Salmon River Canyon, Idaho, 1994.

Time Period	Number of Responses	Number of Stations	Percent
1	5	35	14
2	3	40	8
3	1	28	4
4	0	30	0

Influence of Time Period and Weather Conditions, by Visit: To understand the observer's chance of detecting at least 1 mountain quail vocalization during a visit to the survey area, we examined detections on survey routes by time period, rather than detections per presentation station.

Under those circumstances, the presence of mountain quail was detected on 3 of 4 surveys (75%) during time period 1, on 3 of 5 surveys (60%) during time period 2, on 1 of 4 surveys (25%) during time period 3, and not at all during 4 of 4 surveys during time period 4 (Table 8).

Table 8. Summary of quail responses, by visit and by time period, mountain quail survey technique study, Little Salmon River Canyon, Idaho, 1994.

Time Period	At Least One Response Detected	Number of Visits	Percent Success of Detection When Quail Were Present
1	3	4	75
2	3	5	60
3	1	4	25
4	0	4	--

We further considered the chance of detecting mountain quail by survey route visit, examining data only from temporal and weather conditions that seemed optimum (time periods 1 and 2, no precipitation, and wind force categories of ≤ 2). Under those conditions, 4 survey routes were visited 8 times, and mountain quail were detected along all 4 routes at least once. Quail were not detected on the fifth route, which was only conducted once, during time period 2 (Table 9).

Table 9. Summary of quail responses, by visits during time periods 1 and 2 combined, and under optimum weather conditions (no precipitation and wind force at beginning and ending points ≤ wind force category 2), mountain quail survey technique study, Little Salmon River Canyon, Idaho, 1994.

Survey Route[a]	At Least One Response Detected	Percent Success of Detection When Quail Were Present
Edge Orchard	1	100
Two Springs	1	100
Indian Creek	1	100
Bowen Gulch	1	100

[a] Three Troughs survey not included because it was surveyed only during time period 2.

DISCUSSION

Except in mild winters, mountain quail winter range in the Little Salmon River Canyon is typically at or nearly at river level (elevation approximately 2600 ft). Movement to breeding range most often is up in elevation (generally, 1,000 to 2,000 feet) to areas supporting a conifer/shrub cover type or mountain shrub cover type adjacent to conifer/shrub cover type. In 1994 radio-collared mountain quail in the Little Salmon River Canyon moved to breeding range between mid-March and mid-April. This timeframe is comparable with collared birds' movement to breeding range in 1992 and 1993. In areas where the quail's winter range was in, or immediately adjacent to an area that supported a conifer/shrub cover type, the movement from winter range to breeding range was small. During the mild winter of 1993-1994, some quail remained on or near breeding range, and only made small additional movements to breeding range during late March and early April. However, past data on quail in this area shows that where winter range vegetation was predominantly mountain shrub or riparian tree/shrub cover types, the quail made larger moves up in elevation to breeding range, often moving through isolated corridors of vegetation supporting the riparian shrub/tree cover type. These quail's breeding territories are in riparian shrub/tree, mountain shrub, and conifer/shrub cover types. The riparian shrub/tree cover type identifies a site with woody vegetation that occurs under conditions of higher soil moisture and lower soil temperature than the surrounding or adjacent mountain shrub or grass/forb cover types. We do not use the term riparian to indicate the presence of free-flowing water during any or all parts of the year. In the Little Salmon River Canyon, drainages that contain free water for at least part of the year, as well as draws with no free-flowing water in them during any part of the year, may support the riparian shrub/tree cover type. Radio-collared mountain quail are often found in draws that have no free-flowing water, although they may have seeps and springs, and support vegetation that is associated with the cooler and moister soils found in bottoms and adjacent north-facing slopes. These species include aspen (*Populus tremuloides*), alder (*Alnus* spp.), willow (*Salix* spp.), red-osier dogwood (*Cornus stolonifera*), black hawthorn (*Crataegus douglasii*), and elderberry (*Sambucus cerulea*).

Comparison of rate of detection of mountain quail vocalizations between the IL stations (n = 17), where all detected vocalizations were spontaneous only, and detection of vocalizations at or between the stations with TY, CY, and CA presentation methods, where yelps were either spontaneous or stimulated by the presentation, suggests that the use of a broadcast vocalization increases the vocal activity of targeted quail and, thus, increases likelihood of detecting the presence of mountain quail. This result is similar to findings of other researchers (Levy et al. 1966**,** Stirling and Bendell 1966), who used calls of females to elicit a higher rate of vocal activity than was obtained with listening-only surveys. In addition to allowing a comparison between spontaneous and stimulated vocalizations, use of the different presentation methods (TY, CY, and CA) allowed us to compare the effectiveness of the 2 calls produced using 2 methods. Our results indicate that the Iverson-produced assembly call, at a 13% rate of response, may be the most useful for eliciting yelping by male mountain quail. Use of the Iverson call is also more convenient than use of a tape recorder, especially on a walking route; however, use of a taped assembly call may allow greater standardization of presentation if different surveyors are used in different years. While we did not have a taped assembly call available for use during the survey, a surveyor who used a taped assembly call in a survey in another area successfully eliciting yelping (Vogel, pers. comm.). This higher rate of response by males to the assembly call may be due to the perception that a female is calling. While the assembly call is not diagnostic of the female's vocalizations, it is at least not the diagnostic call of the male, as is the yelp. In addition, during the breeding season, we heard males of broken-up pairs yelp, while the females used the assembly call.

Other researchers have reported differential calling rates related to mated status (Stoddard 1946, Frankel and Baskett 1961, Levy et al. 1966, Mayfield 1981, Baskett 1993), with unmated males calling at higher rates than mated males. While this is difficult to determine, even with the radio-collared quail, we did find that mated males often did not respond to the presented yelp or assembly call. While the presence of at least one yelping male mountain quail was detected in each of the target survey areas, there were often several males present. For instance, 3 radio-collared males were present for the first survey in the Two Springs area. Of those, 2 were known to be mated because the females were also radio-collared. However, the maximum number of yelping birds detected on the route during that visit was 2, 1 of which was identified as being an non-radioed male. We have also noted, over the past several years of field work, that later in the breeding season we have heard several instances of more vigorous, easily-elicited, and longer-duration yelping. For instance, we noted 3 non-radioed males yelping nearly continuously between 1230 and 1530 on 31 May 1994. At the end of June 1993, 3 unmated radio-collared males responded aggressively to a taped yelp, by moving into the open or flying toward the observer, and then yelping from an exposed area. It may be that this late-season vigorous yelping is from males whose nests have been depredated, or from unmated males or males who have lost their mate, and who are available to re-nesting females whose mates are involved in incubation duties. Therefore, while mated males may call less often, earlier and for a shorter period during the breeding season, calling surveys conducted between late May and mid- to late- June may still detect the presence of single males and, thus, the presence of mountain quail in the area.

The optimum weather conditions found for calling surveys for mountain quail are similar to recommendations for other, standard avian surveys (Bibby et al. 1992, Ralph et al. 1993, Cornell Laboratory, no date). Similarly, the temporal change in bird activity noted by several authors (Shields 1977, Robbins 1981, Bibby et al. 1992, Ralph et al. 1993) is also suggested by the results of our mountain quail calling surveys. Based on the results of our study, it appears that surveys to detect the presence of mountain quail are most efficiently conducted between official sunrise and approximately noon, under conditions of no precipitation and wind force at category ≤ 2. Furthermore, the chances of detecting mountain quail when present were increased by visiting the area at least twice, during time periods 1 and 2 (starting at official sunrise and 1000, respectively), with the result that 8 of the 9 responses detected over the entire survey period were recorded during the 2 earliest time periods. Furthermore, we found a higher response rate was achieved when we attempted to elicit responses, rather than just recording spontaneous yelping. Survey results suggest that the yelp and assembly calls produced with the Iverson quail call were as or more successful at eliciting a response than the taped yelp, and the call is more conveniently carried than a tape recorder.

Consequently, while the calling survey conducted under optimum conditions appears to be useful for detecting the presence of mountain quail, it would only provide an estimate of the **minimum** number of mountain quail in the area. However, if the goal of the survey is to detect the presence of mountain quail, collect information on cover types used, or to determine the timing of re-colonization of a previously-vacant area, the calling survey appears to provide the best information for the least amount of time and effort.

Furthermore, calling surveys for mountain quail conducted during the breeding season may be made even more efficient by conducting the surveys in conjunction with other, similar seasonal work that may also be focused on these target areas, such as breeding bird surveys, small mammal trapping transects, or vegetation sampling in late spring or early summer. Thus, if an area is targeted for May or June breeding bird surveys, and the plan is to coordinate the 2 surveys, mountain quail surveys conducted during this period may still provide useful data on presence.

RECOMMENDATIONS

General Considerations: Mountain quail occur in low densities in isolated, linearly-arranged areas of thick brushy habitat. As a consequence, a single-species approach to surveying, rather than an avian community survey or randomly laid-out search pattern, may be the most suitable and economical approach to documenting their presence locally and, on a broader basis, their current distribution. The amount of effort required to sample in a random fashion would be inappropriate, in terms of effort expended in unsuitable habitats. Therefore, data on historic occurrence, current and recent sightings, as well as prior knowledge of the species' habitat use patterns, should be used to identify and prioritize survey areas in which the likelihood of encountering mountain quail may be maximized. This single-species orientation toward surveying is similar to those conducted for bobwhite quail (Stoddard 1946), ruffed grouse, woodcocks, and pheasants (Lancia et al. 1994), and mourning doves (Dolton 1993, Baskett 1993), and is recommended for rare or secretive species occurring in low densities (Fuller and Mosher 1981, Bibby et al. 1992).

<u>Location of Survey Routes and Stations:</u> A survey designed specifically to detect the presence of mountain quail would be most efficiently conducted by systematically placing routes in areas of appropriate habitat. In general, target areas would include drainages and draws supporting riparian shrub/tree, mountain shrub, or conifer/shrub or mosaics and edges combining any of these cover types, especially if lower-elevation winter range, an intervening travel corridor, and upper-elevation breeding range all support woody vegetation.

In Idaho, in particular, areas of historic range, such as riparian corridors or draws along the Snake, Boise, Owyhee, Little Salmon, Salmon, and Clearwater river systems and their tributaries should receive priority. Survey routes need not be limited to drainages containing free water. At a landscape level, examination of topographic maps and aerial photos should be used to identify likely draws and drainages.

Survey time and effort could be further optimized by initially placing survey routes in areas with recent reports of sightings. Additional information on local occurrence could be gleaned from contacts with landowners in the area, especially those who reside at the bottoms of likely draws and whose cooperation could facilitate selection of the correct area for focus; that is, breeding range. Because many mountain quail populations move between lower-elevation winter range and higher-elevation breeding range, not only timing, but location of survey routes in breeding range are considerations for efficient design of calling surveys.

Because the brushy vegetation occupied by the quail is generally confined to the bottoms and north-facing slopes of draws, survey stations should be placed out of the bottom and upslope enabling the observer to walk relatively unimpeded on the opposite, south-facing grass-dominated slope. Listening from such a location, opposite the targeted patch, is preferable, acoustically, to being on the same side as the patch that the quail occupy, because sounds carry farther across a draw than up or down the slope, thus increasing the likelihood that the observer will detect calling when it occurs. In addition, the potential for disturbing the quail is reduced when the observer is not moving noisily through thick vegetation. Distance between stations as well as from the targeted habitat will be dictated by structure and density of the vegetation, topography, or detracting acoustic influences, such as running water. These factors will affect both the surveyor's ability to broadcast calls as well as detect quail vocalizations. For instance, under good weather conditions, yelping by mountain quail can be heard at a distance of about 300 m if the slope is gentle. On the other hand, surveys run in narrow, twisting canyons may require shorter distances between stations in order to have the same likelihood of detecting quail. The suggested distance of 200 m between stations is compatible with, and similar to, that recommended for other avian surveys, which also recommend that in open environments, the distance may be increased between stations because of the greater detectability of the birds' vocalizations.

We found that some of the mountain quail vocalizations were detected while walking between survey stations, and the yelping did not always continue until the next station was reached. Therefore, if vocalizations were only recorded if heard while at stations, some detections would not be recorded. Since the goal of the calling survey is to detect the presence of mountain quail, all vocalizations should be recorded, and survey participants should be directed to walk slowly and quietly between stations in order to be able to detect responses that may have been stimulated as a result of the presentation at the previous station. One way to do this is to number stations as well as the intervals between them; e.g., < 1, 1, < 2, 2, etc. To avoid double-counting, detections should be recorded once in the "initial" column when first heard; all subsequent vocalizations from the same bird should be recorded in the "repeat" column. Thus, all detected responses should be recorded in the appropriate row (station or interval) and column (initial or repeated). A suggested data form is included in Appendix C.

Timing of Survey Period: The yelp is the mountain quail vocalization that is most likely to be detected over long distances. Thus, calling surveys are most appropriately used during the breeding season, when males are more vocal and may be more likely to respond to a broadcast call. Intensity of yelping behavior, both spontaneous and stimulated, may vary over the breeding season. While males yelp year-round, both intensity and duration of yelping behavior seems to increase over the breeding season. Therefore, 1 crucial time restriction is at the beginning of the season. Very early in the season males yelp less often and less vigorously. In addition, surveys conducted in breeding range but run too early, before the birds have moved up from winter range, may yield no detections simply because the quail have not yet arrived. Later in the season males, particularly unmated males, may respond more readily and vigorously to imitated vocalizations, so it may be that the chance of detecting their presence later in the season is increased. However, at the end of the breeding season the majority of mountain quail will be involved in nest attendance and incubation and will probably be less vocal and will be much less visible; therefore, the likelihood of detecting their presence may decline. Thus, the optimum time frame for conducting calling surveys is the period between arrival on the breeding range (early April) and initiation of incubation (generally, mid-June).

Timing and Number of Visits: Robbins (1981) noted the temporal variation in bird activity in several species of birds, including mountain quail. We also found that more vocalizations were detected in the period between sunrise and approximately noon, than in the 2 later time periods. This timing is similar to guidelines for several other avian surveys (Bibby et al. 1992, Ralph et al. 1993, Cornell Laboratory, no date), and thus mountain quail calling surveys could be compatible with other surveys, such as the Breeding Bird Survey.

Whereas Ralph et al. (1993) recommends 1 visit per area, the Breeding Bird Census guidelines (Cornell Laboratory, no date) specify a minimum of 8 visits, with 12 being the recommended number of visits. In our study, 2 visits during the 2 earliest time periods detected the presence of mountain quail in 4 of 4 draws. However, if a targeted area has been given a high priority, yet no mountain quail are detected in the first 2 visits, additional survey visits may be advisable. For instance, if a combination of habitat condition, land ownership, historic occurrence, recent sightings, and conversations with residents has resulted in a high priority, we suggest 3 or 4 calling survey visits, during time periods 1 and 2, both early and late in the breeding season, to aid in the detection of the presence of small populations. If the prioritized areas are adjacent, and the topography permits, several surveys in the 2 optimum time periods could be accomplished by moving from bottom to top in a draw, crossing the ridge, and then surveying from top to bottom along another draw. During the subsequent visit(s), the order of moving through the draws could be reversed, to ensure that each draw was surveyed during each of the 2 time periods.

If presence in such a high priority area is not detected, yet more certain knowledge is desired, follow-up intensive searches using volunteers and dogs may still be worthwhile. Such searches may result in visual sighting, observation of other sign, such as tracks, digging, feathers, or droppings, or stimulation of diagnostic vocalizations (such as yelps, alarm calls, or assembly calls). Intensive searches may be best conducted in the winter, when visual detectability of the quail would be greater, due to concentration in larger winter coveys in a smaller area on low elevation winter range, in conditions of decreased visual obstruction from the vegetation. In addition, snow would increase the birds' visibility against the snow and would improve searchers' ability to detect their presence through sightings of tracks or feathers at plucking sites left by predators.

Weather Conditions: Guidelines for many types of avian surveys also consider mild or warm temperatures, little or no precipitation, and relatively calm air movement to be the optimum weather conditions (Bibby et al. 1992, Ralph et al. 1993). We found these to be the optimum conditions of a mountain quail calling survey, as well, and thus, the similarity in guidelines indicates that mountain quail surveys could be compatible with other avian surveys.

Training: As in any survey that depends on the reliable and accurate detection of vocalizations, training of survey participants can ensure detections and thus improve the accuracy of survey results and reduce variability between observers. Participants' hearing should be checked, and they should also be aware of components of suitable habitat, survey methods, use of an Iverson quail call, and the behavior of mountain quail, in addition to being completely familiar with several vocalizations.

Annual Counts: If conducted annually, calling surveys for mountain quail could provide population trend data as well as information on local as well as regional changes in the species' distribution. However, to be comparable between years, routes should be revisited annually at the same season, preferably by the same observer, to reduce biases attributable to variations between observers. Ideally, the surveys done over several years would be conducted under the same weather conditions; some adjustments can be made for variations in weather conditions by conducting surveys only under standardized, suitable wind and precipitation conditions. If the mountain quail calling survey is to be an annual survey, routes and survey stations should be recorded on topographic maps and survey station points should be permanently marked in the field, to ensure subsequent survey participants will use the same stations.

Summary: Results of mountain quail calling surveys may provide data on presence of mountain quail in an area, establish the location of breeding range, and yield information on cover type associations, distribution and, if conducted annually, provide information on population trend and range expansion or contraction. Detection of quail will yield only minimum numbers, however, because not all quail may respond, and will only provide knowledge of the location of breeding range. However, once the presence of quail on breeding range has been documented, the location of winter range can be determined through winter searches, which may also yield better data on population size.

Design of a mountain quail calling survey should involve identification, selection, and prioritization of potential areas to be surveyed, using information on cover type, historic occurrence, recent sightings, as well as knowledge of behavior, vocalizations, habitat use patterns, and timing of annual movement to breeding range.

Survey participants should have good hearing ability, should be trained in aspects of mountain quail behavior, should be familiar with their appearance and common vocalizations, and must be thoroughly acquainted with the survey methods. In addition, surveyors should gain expertise in use of the Iverson quail call before surveying any areas.

Appendix C contains a suggested data form, together with explanations and codes. A suggested survey protocol is presented in Appendix D. Equipment and transportation needs for calling surveys will depend on whether the survey is a walking or driving route, but suggested minimum equipment requirements are listed in Appendix E.

Surveys should be conducted during the breeding season, after the mountain quail have arrived on breeding range, but before the majority of the quail have begun incubation (between the beginning of April and mid-June). Calling surveys for mountain quail should be run under standardized temporal and weather conditions, and these are compatible with other standard avian surveys. Routes should be visited 2 or more times (depending on the area's priority rating), during the 2 early time periods (start times of official sunrise and 1000), and under conditions of no precipitation and little or no air movement. If surveys are to be conducted annually, routes, stations, conditions, forms, and seasonal timing should be standardized to reduce variability.

All detections of mountain quail in Idaho should be forwarded to the Conservation Data Center, Idaho Department of Fish and Game, P.O. Box 25, Boise, ID 83707.

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Appendix A

Categories and Codes
Mountain Quail Calling Survey
Little Salmon River
1994

<u>Time Periods (start times)</u>

1 = official sunrise time
2 = 1000
3 = 1500
4 = no earlier than 2 hours before official sunset time

<u>Weather Condition Descriptions</u>

<u>Precipitation</u>

0 = no precipitation
1 = occasional drops or intermittent rain
2 = constant rain or drizzle
3 = snow, sleet, or hail

<u>Cloud Cover</u>

0 = clear
1 = partly cloudy (scattered clouds, < 50% coverage)
2 = mostly cloudy (scattered clouds, ≥ 50% coverage)
3 = fully cloudy (unbroken cloud cover)
4 = fog, or heavy, low mist or ground-level clouds

<u>Wind Speed (Beaufort Wind Scale)</u>

	mph
0 = calm, no wind	<1
1 = light air movement	1-3
2 = light breeze	4-7
3 = gentle breeze	8-12
4 = moderate breeze	13-18

Appendix A
(continued)

Categories and Codes
Mountain Quail Survey
Little Salmon River
1994

Survey Presentation Method Codes

IL = initial listen
CA = call-assembly
CY = call-yelp
TY = tape-yelp

Call or Response Codes

AC = assembly call
Y = yelp
O = other vocalization (describe)
M = moved away
F = flushed

Cover Type Codes

0 = riparian/tree/shrub
1 = riparian/shrub
2 = mountain shrub
3 = conifer/shrub
4 = grass/scattered shrub
5 = agricultural
6 = residential
7 = road
8 = grass
9 = rocky outcrop

Appendix B

Beaufort Scale of Wind Force

Force	Description	Means of Recognition Without Instruments	Wind Speed in mph
0	Calm	Smoke rises vertically.	<1
1	Light air	Direction shown by smoke, but not by wind vanes.	1-3
2	Light breeze	Wind felt on face; leaves rustle, ordinary vane moved by wind.	4-7
3	Gentle breeze	Leaves and small twigs in constant motion; wind extends light flag.	8-12
4	Moderate breeze	Raises dust and loose paper; small branches are moved.	13-18
5	Fresh breeze	Small trees in leaf begin to sway; crested wavelets form on inland water.	19-24
6	Strong breeze	Large branches in motion; whistling heard in tele-graph wires; umbrellas used with difficulty.	25-31
7	Moderate gale	Whole trees in motion; inconvenience felt when walking against the wind.	32-38
8	Fresh gale	Breaks twigs off trees; generally impedes progress.	39-46
9	Strong gale	Slight structural damage occurs, e.g. chimney pots and slates removed.	47-54

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Appendix C

Suggested Survey Data Forms
Explanations and Codes for Data Forms
Mountain Quail Calling Survey

CALLING SURVEY DATA FORM
MOUNTAIN QUAIL CALLING SURVEY

OBSERVER	DATE	JULIAN	PAGE
			Number of

SURVEY ROUTE	VISIT	START TIME	STOP TIME	TIME PREIOD

CLOUD COVER			WIND		
Beg	Mid	End	Beg	Mid	End

TEMPERATURE			PRECIPITATION		
Beg	Mid	End	Beg	Mid	End

UTM COORDINATES	
Easting (beginning)	Northing (beginning)
Easting (ending)	Northing (ending)

STARTING POINT DESCRIPTION

ENDING POINT DESCRIPTION

(CONTINUED)

CALLING SURVEY DATA FORM
MOUNTAIN QUAIL CALLING SURVEY
(continued)

OBSERVER	DATE	SURVEY ROUTE	PAGE
			Number of

STATION	ELEVATION	COVER TYPE	TYPE	ACTIVITY	INITIAL	REPEAT

(CONTINUED)

CALLING SURVEY DATA FORM
MOUNTAIN QUAIL CALLING SURVEY
(continued)

OBSERVER	DATE	SURVEY ROUTE	PAGE
			Number of

TARGET AREA VEGETATION (DOMINANT, CO-DOMINATE SPECIES)
Trees
Shrubs
Herbaceous

TRAVEL METHOD			
TIME ELAPSED		LINEAR DISTANCE COVERED (m)	
NUMBER OF MOUNTAIN QUAIIL DETECTED		OFFICIAL SUNRISE	
OFFICIAL HIGH TEMPERATURE		OFFICIAL LOW TEMPERATURE	
AVAILABLE WATER	Type		Distance (m)
PHOTOS TAKEN? (describe)			

COMMENTS

EXPLANATIONS AND CODES FOR DATA FORMS
MOUNTAIN QUAIL CALLING SURVEY

OBSERVER
Enter your first and middle initials and last name

DATE
Enter calendar date
Example
03-03-95

JULIAN
Enter Julian calendar date

PAGE
Enter the individual page number of the total pages per visit
Example
Number 2 of 3

SURVEY ROUTE
Enter route name

VISIT
Enter the visit number
Example(s)
1. 1st visit
2. 2nd visit

START TIME
Fill in starting time in visit in military hours
Example
0545

STOP TIME
Fill in ending time for this visit in military hours
Example
1125

TIME PERIOD
Enter the code for the time period
1 start at official sunrise
2 start at 1000

EXPLANATIONS AND CODES FOR DATA FORMS
MOUNTAIN QUAIL CALLING SURVEY

(continued)

CLOUD COVER (record at beginning, middle, and end points)
Enter the code that best describes the cloud cover
1 Clear (< 10% cloud cover over entire sky)
2 Scattered clouds (10% to < 50%)
3 Broken (50 to < 90%)
4 Overcast (≥ 90%)
5 Fog, or heavy, low mist or ground-level clouds

WIND (record at beginning, middle, and end points)
Enter the code that best describes the wind condition, using the Beaufort Scale of Wind Force.

TEMPERATURE (record at beginning, middle, and end points)
Enter the temperature in degrees Fahrenheit.

PRECIPITATION (record at beginning, middle, and end points)
Enter the code that best describes the level of precipitation.
1 none
2 occasional showers
3 constant light rain
4 sleet, snow, or hail

UTM COORDINATES (record at beginning and end points)
Enter easting and northing, using topographic map and UTM grid, per Grubb and Eakle.[1]

STARTING/ENDING POINT DESCRIPTION
Describe the area's topography, habitat; note any prominent, permanent features.

[1] Grubb, T. G., and W. L. Eakle. 1988. Recording wildlife locations with the Universal Transverse Mercator (UTM) grid system. USDA For. Serv., Rocky Mt. For. and Range. Exp. Stn., Res. Note RM-483. 3pp.

EXPLANATIONS AND CODES FOR DATA FORMS
MOUNTAIN QUAIL CALLING SURVEY

(continued)

STATION

Record the number of the station or interval between stations.

Example(s)

<1
1
<2
2

ELEVATION

Record the elevation at each station, using an altimeter

COVER TYPE

Enter the code(s) that best describe(s) the habitat occupied by the quail

0 riparian tree/shrub
1 = riparian/shrub
2 = mountain shrub
3 = conifer/shrub
4 = grass/scattered shrub
5 = agricultural
6 = residential
7 = road
8 = grass
9 = rocky outcrop

TYPE

Record the type of detection.

1 aural
2 visual
3 both

ACTIVITY

Enter the code that best describes the quail's activity

1 yelp
2 assembly call
3 other vocalization
4 flushed
5 walked

INITIAL

To avoid double-counting, record each bird only once in the Initial column, when it is first detected.

EXPLANATIONS AND CODES FOR DATA FORMS
MOUNTAIN QUAIL CALLING SURVEY

(continued)

REPEAT

After the initial detection and notation in the initial column, all subsequent vocalizations of the same bird are to be recorded in the repeat column.

TARGET AREA VEGETATION

Enter the appropriate species abbreviations from the attached list.

TRAVEL

Record method of travel while surveying

1 walking
2 driving

TIME ELAPSED

Record the time elapsed between the beginning and ending points of the survey route.

LINEAR DISTANCE COVERED

Record the linear distance, in meters, between the beginning and ending points.

NUMBER OF MOUNTAIN QUAIL DETECTED

Enter the number of individual mountain quail detected.

OFFICIAL SUNRISE

Record the official sunrise for the date of the visit, from the official sunrise chart.

OFFICIAL HIGH TEMPERATURE
OFFICIAL LOW TEMPERATURE

Record the official high and low temperatures for the day.

AVAILABLE WATER

Record the type (seep, spring, stream, river) of free water, if any, and the approximate distance from the targeted habitat.

PHOTOS TAKEN

If photos were taken, record the frame(s) and describe the subject.

Plant Codes[1]

Some Commonly-Observed Vegetation

Code	Scientific Name	Common Name
Agsp	Agropyron spicatum	Bluebunch wheatgrass
Brte	Bromus tectorum	Cheatgrass
Cage	Carex geyeri	Elk sedge
Caru	Calamagrostic rubsecens	Pine grass
Dagl	Dactylis glomerata	Orchard grass
Elgl	Elymus glaucus	Blue wildrye
Feid	Festuca idahoensis	Idaho fescue
Kocr	Koeleria cristata	June grass
Posa	Poa sandbergii	Sandberg's bluegrass
Acgl	Acer glabrurn	Rocky Mountain maple
Amal	Amalanchier alnifolia	Serviceberry
Cere	Celtis reticulata	Netleaf hackberry
Cost	Cornus stolinifera	Red-osier dogwood
Crdo	Crategus douglasii	Black hawthorn
Hodi	Holodiscus discolor	Ocean-spray
Phle	Philadelphus lewisii	Syringa
Phma	Physocarpos malvaceus	Ninebark
Perm	Prunus emarginata	Bitter cherry
Prvi	Prunus virginiana	Chokecherry
Rhgl	Rhus glabra	Smooth sumac
Rila	Ribes lacustre	Prickly currant
Rosa	Rosa spp.	Rose
Sace	Sambucus cerulea	Blue elderberry
Sasc	Salix scouleriana	Scouler's willow
Syal	Symphoricarpos albus	Snowberry
Abgr	Abies grandis	Grand fir
Beoc	Betula occidentalis	Water birch
Pipo	Pinus ponderosa	Ponderosa pine
Potr	Populus tremuloides	Aspen
Potr2	Populus trichocarpa	Black cottonwood
Psme	Pseudotsuga menzesii	Douglas-fir

[1] This is an example of a list used in the Little Salmon River Canyon; a similar list, containing common species in the relevant area, should be developed for each survey site.

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Appendix D

Suggested Survey Protocol
Mountain Quail Calling Survey

Time Periods (Starting Times)

official sunrise time

1000

Weather Conditions

Surveys should be done under conditions of no precipitation and little or no air movement (≤ 2 wind force category, from the Beaufort Scale of Wind Force).

Survey Methodology

Begin the survey at lowest (or highest) accessible point. Where the ridgeline does not intervene and walking is possible, go from lowest permitted access point and cover at least 8 stations (more, if possible), or until interfering noise (river or highway noise, for instance) prohibits detection of mountain quail vocalizations.

Survey stations should be located up out of the bottom (to avoid possible interfering noises from running water), on the more open slope, enabling the observer to talk relatively unimpeded, and thus more quietly. Each station should be approximately 200 meters past the previous station; however, this distance is dictated by features of the habitat, terrain, or presence of interfering noises. For instance, if you believe that topographic features, such as steep, winding canyon walls, would prevent you from hearing quail vocalizations at a distance of 200 meters, shorten the distance between stations, and note that change.

At the beginning point for the survey route, record your name, date, time, and name of the survey route, as well as other pertinent information about the site and the weather conditions [see suggested data form, Appendix C].

At each point, listen for 2 minutes; then use the presentation method (assembly call produced with the Iverson call) for 2 minutes; then listen again for 2 minutes. The goal of the calling survey is to detect the presence of mountain quail; therefore, record **all** detections of mountain quail by type (e.g. aural or visual), whether they occur while you are at stations or in the intervals between stations. One way to do this is to number stations (e.g. 1, 2, 3, etc.) as well as the intervals between stations (e.g., < 1, < 2, etc.) No individual should be recorded more than once in the initial column; all subsequent detections of the same individual are to be recorded in the repeat column. Thus, all detected responses should be recorded in the appropriate row (station or interval) and column (initial or repeat) [see suggested data form, Appendix C].

SUGGESTED SURVEY PROTOCOL
MOUNTAIN QUAIL CALLING SURVEY

(continued)

Survey Methodology (continued)

At the end point for the survey route, record information about the site, weather conditions, and time elapsed. Also summarize the number of mountain quail detected, at or between stations, and add any relevant comments [see suggested data form, Appendix C].

Each targeted area should be surveyed at least once during each of the 2 time periods. If possible, survey the route in the opposite directions) on any subsequent visit(s). That is, if on the first visit you ran a survey up one draw and another survey down an adjacent draw, then on the second visit, reverse the order.

Appendix E

Equipment List
Mountain Quail Calling Survey

tape recorder

training tapes

Iverson quail call*

official sunrise/sunset chart

maps (topographic quads, 7.5 min.)

UTM grid

aerial photos (optional)

watch

altimeter

thermometer

Beaufort Scale of Wind Force

survey protocol

survey data form, explanations and codes

clipboards, and pencils or pens

* available from: Iverson Calls
P.O. Box 917
Novato CA 94948
415-897-9179

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